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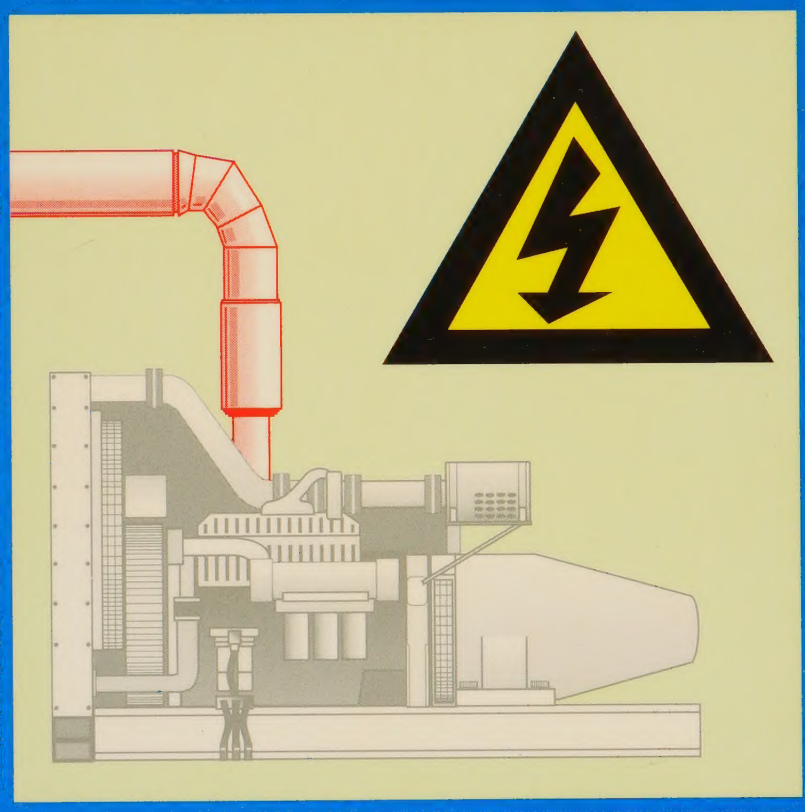
Health Technical Memorandum 2011

Validation and verification

Emergency electrical services



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Health Technical Memorandum 2011

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About this publication

Health Technical Memoranda (HTM) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of health care.

They are applicable to new and existing sites, and are for use at various stages during the inception, design, construction, refurbishment and maintenance of a building.

Health Technical Memorandum 2011

HTM 2011 focuses on the:

- legal and mandatory requirements;
- design applications;
- maintenance; and
- operation,

of emergency and essential electrical supply equipment in all types of health care and personal social services premises.

It is published as four separate volumes each addressing a specialist discipline.

- This volume – **Validation and verification** – details the requirements for ensuring that manufactured equipment is formally tested and certified as to contract and manufactured to the highest level of quality assurance. The importance of commissioning is emphasised and the order of tests on site is listed. Routine testing, which is a subset of these commissioning tests, is also reviewed;

- **Management policy** – outlines the overall responsibility of managers of health care and personal social services premises, and details their legal and mandatory obligations in setting up and operating a reliable emergency electrical supply. It summarises the technical aspects involved and concludes with a list of definitions;

- **Design considerations** – highlights the overall requirements and considerations that should be

applied to the design up to the contract document;

- **Operational management** – provides information for those responsible for overseeing and operating day-to-day running and maintenance. Coverage includes stand-by generators, batteries, test runs and record keeping. Supplementary power for peak periods, and combined heat and power systems are also discussed.

Guidance in this Health Technical Memorandum is complemented by the library of National Health Service Model Engineering Specifications. Users of the guidance are advised to refer to the relevant specifications for "Emergency supply".

The contents of this Health Technical Memorandum in terms of management policy, operational policy and technical guidance are endorsed by:

- The Welsh Office for the NHS in Wales;
- The Health and Personal Social Services Management Executive in Northern Ireland;
- The National Health Service in Scotland Management Executive,

and set the required standards consistent with Departmental Cost Allowances.

References to legislation appearing in the main text of this guidance apply in England and Wales. Where references differ for Scotland and/or Northern Ireland these are given as marginal notes.

Where appropriate, marginal notes are also used to amplify the text.

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1.0 Scope

General

1.1 Health care and personal social services premises are totally dependent upon electrical power supplies, not only to maintain a safer and more comfortable environment for patients and staff, but also to give greater scope for treatment using sophisticated medical equipment at all levels of clinical and surgical care. Changes in application, design and statutory requirements have led to the introduction of a new generation of equipment and new standards of reliability.

1.2 Interruptions in electrical power supplies to equipment can seriously disrupt the delivery of health care with serious consequences for patient well-being. Health care and personal social services premises must therefore ensure that they can continue to provide electrical power to essential services in the event of prolonged or short disruption to supplies.

Emergency electrical services

1.3 Emergency electrical services form an integral part of the health care and personal social services premises supply network in meeting both safety and functional requirements. They can be in the form of batteries, uninterrupted power supply (UPS) systems, or stand-by generators.

1.4 The provision of emergency electrical services in health care and personal social services premises is a management responsibility at both new and existing sites. This guidance is equally applicable to premises which offer acute health care services under the Registered Homes Act 1984.

Nursing Homes and Agencies Act (Northern Ireland) 1971
Nursing Homes Regulations (Northern Ireland) 1974
Registered Establishments (Scotland) Act 1987

2.0 Testing, handing over procedure and documentation

Works testing

2.1 Emergency generator sets should be tested as a complete unit, that is with their associated control equipment for output and performance in accordance with the relevant British Standards (BS5514, BS4999, BS5000, Part 3 and BS6667).

2.2 Type test certificates should be provided with the tender for engine and generator. Routine works test certificates should be provided for each engine and generator and be available before the site testing.

Site testing

2.3 Before any dynamic tests are carried out on a new engine or generator, the following procedures and static tests should be carried out:

a. descaling of connecting pipework carrying lubricating oil, starting air and jacket water, using a dilute solution of citric acid. After an approved dwell time the pipework should be flushed with clean water. Ex works descaled pipework should be end-sealed before dispatch to site;

b. temporary strainers should be inserted into the oil pipework before the lubricating oil strainers, for periodic examination. The strainers must remain free of debris before their removal for the final test performance of the engine;

c. crankshaft deflection checks should be carried out at the engine main bearings for maintenance records;

d. the insurance inspection certificate for the starting air cylinders and associated pipework should be checked, if provided;

e. the insulation resistance of the generator stator winding should be checked by a megger-type insutrument, with a preferred DC voltage output twice the stator-rated voltage;

f. using an electronic or motorised megger-type instrument, the Polarisation Index (PI) of the HV generator stator winding should be determined over a period of one and 10 minutes, for maintenance records. PI is defined as the final insulation reading (10 minutes) divided by the initial insulation reading (one minute). A value above "2" should be expected for a sound winding;

g. measurement of the insulation resistance across the bed plate insulating liner at the non-driving end bearing of the generator;

h. measurement of the insulation resistance of the main field winding. The rectifying diodes should first be disconnected to avoid damaging them;

j. measurement of the insulation resistance of the 240V stator winding heaters;

k. measurement of the insulation resistance of the stator winding and connected power cables immediately before energisation;

m. measurement of the insulation resistance of the exciter stator winding and connected cables, with the AVR disconnected;

n. measurement of the insulation resistance of the primary and secondary windings and vector configurations of the HV power and voltage transformers. Oil and Buchholz tests will be required for the conservator-type transformer;

p. measurement of the insulation resistance of all control wiring. Solid state devices should be disconnected if possible. If not, the tests should be carried out at a voltage approved by the manufacturer, and in any case at not more than 25V DC;

q. the 240V stator winding heaters should be connected to a temporary supply on all HV generators on arrival at site, and stator winding insulation monitored weekly.

2.4 Dynamic tests on the engine should only be carried out after calibration and testing of the instrument sensors and the electrical protection relay and phase sequence rotation tests.

2.5 Protection tests to sensors and relays should be carried out as follows:

a. make a record of the protection, indication and control current transformer serial number and type;

b. check current transformer ratio, resistance, polarity and magnetising curves;

c. check secondary injection of electrical protection relays;

d. test water jacket temperature alarm and trip;

e. test lubricating oil pressure alarm and trip by operation of sensor oil bypass valve;

f. test lubricating oil low pressure start interlock;

g. test overcrank (failure to start alarm);

h. check minimum drop out and close voltages of all control relays and contactor coils.

Dynamic tests

2.6 The dynamic tests on site should include the following witnessed observations:

a. lubricating oil pressure and pressure trip;

b. lubricating oil and jacket water bypass automatic valves opening during engine warm-up; and

a series of test starts and checks, as follows:

c. the ability to start up within the specified time;

d. overspeed trip;

e. speed variation within specified limits;

f. voltage regulation and open circuit characteristic;

g. electrical trips of generator by overcurrent, reverse power protection relays at minimum plug settings with generator below 25% FL (or primary injection);

h. a full load run of not less than four hours, followed by a one hour, 10% overload test and full load protection trip. The test full load should be obtained by either a ballast load bank, or synchronised to the normal supply;

j. fuel oil inlet pressure;

k. fuel oil injector settings;

m. temperature rise of jacket cooling water;

n. temperature rise of lubricating oil;

p. temperature rise of charge air across turbocharger, if fitted;

q. temperature of exhaust gases at each cylinder head;

r. 240V stator winding heater disconnects when circuit breaker closes;

s. ambient conditions;

t. noise acoustic levels, engine/background.

Final test inspection

2.7 Upon completion of the tests, a thorough mechanical inspection of the diesel generator set and examination of recorded test results must be made to ensure that it conforms to contract.

Generator phase rotation

2.8 Standard phase sequence rotation is defined as electrical phase voltage rotation ABC when the generator shaft rotation is **clockwise** as viewed from the drive coupling end of the generator. BS4999, Part 108, 1987 refers.

2.9 Before any electrical load is connected the rotation of every generator must be checked and the voltage standard phase sequence rotation set at the generator and confirmed at the circuit breaker. Synchronising equipment must be ''phased in'' before a generator is connected in parallel with another generator or to the supply.

2.10 Before emergency generator sets can be operated in parallel with other generators connected to the normal supply, electrical protection tests and operational procedures must be agreed with, and subsequently demonstrated to, the regional electricity company's nominated engineer.

3.0 Emergency lighting

3.1 It is desirable that all batteries intended for the provision of energy for emergency luminaires are checked for operation.

Self-contained luminaires

3.2 The operation of self-contained luminaires should be verified after the normal supply has been connected to the sub-circuit for at least 24 hours.

3.3 Luminaires should be disconnected from the normal supply, initially during daylight hours, to discover any malfunctions. When dark, the level of illumination should be measured and recorded under simulated escape conditions.

Battery load test

3.4 An emergency battery's source capacity should be verified after an adequate first charge, based on the battery's ampere-hour capacity rating. Discharge tests should be carried out into a load bank at the maximum rated current for the endurance period stated in the battery guarantee. If a load bank is not obtainable, discharge should be carried out into all emergency luminaires connected, for the required period of one to three hours.

3.5 DC auto-changeover switches should be checked for freedom of operation by removing/reinserting the control coil fuse link.

Standby lighting

3.6 All standby lighting should be checked for "stand alone" suitability and the illumination of the working area measured and recorded.

4.0 Uninterruptible power supplies

4.1 The uninterruptible power supply (UPS) must provide a no-break rated supply to the load equipment for the required endurance period. The equipment must continue to function normally when the normal supply is disconnected. The battery endurance capacity in ampere-hours should be verified under load conditions.

Inverter bypass operation

4.2 The operation of the inverter bypass switch should be checked for failure of the inverter, battery charger or battery supply.

4.3 Auto-synchronisation of the inverter output frequency with the normal supply frequency at the inverter by-pass switch should be demonstrated and recorded, using a load bank, before connection of electronic/electrical equipment.

Waveform

4.4 The UPS input and output harmonic on-load waveform voltage should be recorded and analysed.

Noise

4.5 The acoustic noise levels emitted by the inverter under maximum load should be measured for comparison with guaranteed levels. Noise levels should also be measured in adjacent areas.

Indications and alarms

4.6 All local and remote indications and associated alarm combinations relevant to normal use or failure in operation must be demonstrated and recorded.

Other publications in this series

(Given below are details of all Health Technical Memoranda available from HMSO. HTMs marked (*) are currently being revised, those marked (†) are out of print. Some HTMs in preparation at the time of publication of this HTM are also listed.)

1 Anti-static precautions: rubber, plastics and fabrics*†
2 Anti-static precautions: flooring in anaesthetising areas (and data processing rooms)*, 1977.
3 –
4 –
5 Steam boiler plant instrumentation†
6 Protection of condensate systems: filming amines†
7 Electrical services: supply and distribution*†
8 –
9 –
10 Sterilizers*†
12 –
13 –
14 Abatement of electrical interference*†
15 Patient/nurse call systems†
16 –
17 Health building engineering installations: commissioning and associated activities, 1978.
18 Facsimile telegraphy: possible applications in DGHs†
19 Facsimile telegraphy: the transmission of pathology reports within a hospital – a case study†
20 Electrical safety code for low voltage systems (in preparation)
21 Electrical safety code for high voltage systems*†
22 Piped medical gases, medical compressed air and medical vacuum installations*†
22 Supp. Permit to work system: for piped medical gases etc†
23 Access and accommodation for engineering services†
24 –
25 –
26 Commissioning of oil, gas and dual fired boilers: with notes on design, operation and maintenance†
27 Cold water supply storage and mains distribution* [Revised version will deal with water storage and distribution], 1978.
28 to 53 –

Component Data Base

54 User manual, 1989.
55 Windows, 1989.
56 Partitions, 1989.
57 Internal glazing, 1989.
58 Internal doorsets, 1989.
59 Ironmongery, 1989.
60 Ceilings, 1989.
61 Flooring, 1989.
62 Demountable storage systems, 1989.
63 Fitted storage systems, 1989.
64 Sanitary assemblies, 1989.
65 Signs†
66 Cubicle curtain track, 1989.
67 Laboratory fitting-out (in preparation)
68 Ducts and panels for sanitary assemblies (in preparation)
69 Protection (in preparation)
70 Fixings (in preparation)
71 to 80 –

Firecode

81 Firecode: fire precautions in new hospitals, 1987.
82 Firecode: alarm and detection systems, 1989.
83 Fire safety in health care premises: general fire precautions*†
84 Fire precautions in new residential care premises (in preparation)
85 [Revision to Home Office draft guidance in preparation]
86 Firecode: Assessing fire risks in existing hospital wards, 1987.
87 Firecode: textiles and furniture, 1987.
88 Fire safety in health care premises: guide to fire precautions in NHS housing in the community for mentally handicapped/ill people, 1986.

New HTMs in preparation

Lifts
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Telecommunications
Washers for sterile production
Special ventilation systems
Risk management and quality assurance

Health Technical Memoranda published by HMSO can be purchased from HMSO Bookshops in London (post orders to PO Box 276, SW8 5DT), Edinburgh, Belfast, Manchester, Birmingham and Bristol or through good booksellers. HMSO provide a copy service for publications which are out of print; and a standing order service.

Enquiries about Health Technical Memoranda (but not orders) should be addressed to:
NHS Estates, Department of Health, Room 313,
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Enquiries should be addressed to: NHS Estates, Euston Tower, 286 Euston Road, London NW1 3DN. Telephone: 071-388 1188.

Some other NHS Estates products

Activity DataBase – a computerised system for defining the activities which have to be accommodated in spaces within health buildings. *NHS Estates*

Design Guides – complementary to Health Building Notes, Design Guides provide advice for planners and designers about subjects not appropriate to the Health Building Notes series. *HMSO*

Estatecode – user manual for managing a health estate. Includes a recommended methodology for property appraisal and provides a basis for integration of the estate into corporate business planning. *HMSO*

Capricode – a framework for the efficient management of capital projects from inception to completion. *HMSO*

Concode – outlines proven methods of selecting contracts and commissioning consultants. Both parts reflect official policy on contract procedures. *NHS Estates*

Works Information Management System – a computerised information system for estate management tasks, enabling tangible assets to be put into the context of servicing requirements. *NHS Estates*

Option Appraisal Guide – advice during the early stages of evaluating a proposed capital building scheme. Supplementary guidance to Capricode. *HMSO*

Health Building Notes – advice for project teams procuring new buildings and adapting or extending existing buildings. *HMSO*

Health Guidance Notes – an occasional series of publications which respond to changes in Department of Health policy or reflect changing NHS operational management. Each deals with a specific topic and is complementary to a related Health Technical Memorandum. *HMSO*

Encode – shows how to plan and implement a policy of energy efficiency in a building. *HMSO*

Firecode – for policy, technical guidance and specialist aspects of fire precautions. *HMSO*

Nucleus – standardised briefing and planning system combining appropriate standards of clinical care and service with maximum economy in capital and running costs. *NHS Estates*

Concise – software support for managing the capital programme. Compatible with Capricode. *NHS Estates*

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